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Publications taken into consideration in judging patentability:

DE	36 10 797 A1
DE	34 01 883 A1
GB	20 03 002 A
US	33 83 466

Process for improving the reliability of speech controls of function elements and device for carrying out same

In a process and a device for the reliable recognition of at least the beginning of a speech command for the speech control of function elements, signals of a first microphone impressed with structure-borne sound of an operating person is used for triggering a second microphone directed toward the mouth of the operating person, in order to improve the reliability of the speech control in the presence of background noise stress.

Patent Claims

1. Process for improving the reliability of speech controls of function elements at work stations or in motor vehicles by measures for the reliable recognition of the beginning of speech commands in a speech recognition circuit,
wherein a first microphone is primarily impressed with sound generated during speaking, and
a second microphone is impressed at least with background noise, and
wherein signals generated in both microphones are brought electrically into a specific relationship with one another in order to prevent the erroneous interpretation of pure background noise as a speech command,
characterized in that
the first microphone is impressed with structure-borne sound of an operator generated during speaking, and
the second microphone, which is directed at a spatial distance to the mouth of the operator, and thereby further is impressed with sound generated during speaking, electrically switching to the speech recognition circuit for the speech signal transmission takes place, if the first microphone generates signals from the structure-borne sound.

2. Device for carrying out the process as claimed in claim 1,
with a first microphone impressable primarily with sound waves generated during speaking,
with a second microphone impressable at least with background noise, and
with an electric circuit, which establishes a specific relationship between electric signals generated by the two microphones and supplies output signals

to a speech recognition circuit,
characterized in that
the first microphone (2) is implemented as a structure-borne sound microphone in contact with a body part of an operator,
the second microphone (5) is directed at a spatial distance to the mouth of the operator and further is impressed with sound generated during speaking, and the electric circuit is developed as a trigger circuit (10) addressably by the signals generated by the first microphone (2), in order to establish a switching relation between signals of the first (2) and of the second microphone (5), which switching relation only makes possible the supply of signals of at least the second microphone (5) as output signals to the speech recognition circuit (14) if simultaneously signals of the first microphone (2) are present at the trigger circuit (10).

3. Device as claimed in claim 2, characterized in that the first microphone (2) is a throat microphone which can be placed against the throat of the operator.

4. Device as claimed in claim 3, characterized in that both microphones (2, 5) are fastened on harnesses (1, 3), which can be put on by the operator.

5. Device as claimed in claim 2, characterized in that further a casing (9) to be worn by the operator is provided for receiving
   - the trigger circuit (10) electrically connected with both microphones (2, 5),
   - a transmitter (11) for the wireless transmission of output signals of the trigger circuit (10) to a receiver (13) of the speech recognition circuit (14), and
   - an electric energy store (12) for feeding at least the trigger circuit (10) and the transmitter (11).

6. Device as claimed in claim 2, characterized in that the signals of the first microphone (2), further, for optimizing the recognizability of the signals of the second microphone (5) are electrically linked with them.

7. Device as claimed in claim 2, characterized in that a time element (T) with a time constant is provided, which can be set to the maximum word receiving duration of the speech recognition circuit (14), which interrupts the supply of output signals of the trigger circuit (10) to the speech recognition circuit after passage of the set time constant.

8. Device as claimed in claim 7, characterized in that a signal transmitter (10.3; 4) is provided which, after passage of the time constant, is activated for generating a signal to the operator.

9. Device as claimed in claim 2, characterized in that
the trigger circuit (10) comprises a threshold value switch (10.1), which compares the electric signals of the first microphone (2) with a settable threshold value, and
that a switch (10.2) closable by the threshold value switch (10.1) in the presence of signals of the first microphone (2) above the threshold value is looped into the path of the electric signals of the second microphone (5).

10. Device as claimed in claim 5, characterized in that
the casing (9) comprises a first casing part (9.1) for receiving the trigger circuit (10) and a second casing part (9.2) for receiving the transmitter (11) and the energy store (12), and
the trigger circuit (10) is electrically connected to the transmitter (11) and the energy store (12) by means of a multipole plug connection (15; Fig. 2) disposed between the two casing parts (9.1, 9.2) and coupling them.

11. Device as claimed in claim 9, characterized in that the time element (T) is integrated into the electric switch (10.2).

12. Device as claimed in claim 2, characterized in that an interrupter switch (6.1) is connected into a connection (6) between the first microphone (2) and the trigger circuit (10).

Specification

The invention relates to a process according to the preamble of process claim 1 and to a device for carrying out the process according to the invention, which comprises the characteristics of the preamble of the device claim 2.

A process of this type can be derived from the operational function of a device known from DE-OS 36 10 797. This comprises already a speech microphone and a background noise microphone whose signals are brought into relationship through electrical subtraction. In the subtraction the noise components - in particular background noise - impressing the two microphones equally are eliminated such that the resulting residual signals can readily be interpreted as speech commands. Through the beginning of the speech signal remaining after the subtraction, a change-over switching, for example, from receiving to sending operation of a hands-free telephone is said to take place only if there is a genuine need.

In order to keep to a minimum the component of speech sound impression of the background noise microphone during speaking of the operator, this must be disposed at some distance from the mouth of the operator. But therefrom results that the background noise level at the background noise microphone does not necessarily correspond to that at the speech microphone such that even without speech impression of the latter, the result of the subtraction of the signals of both microphones always switched to transmitting stand-by does not need to be equal to zero. Therefore an error control can here also not be excluded.

Further other devices are known with comparable function, each of which only switches over a single speech microphone to transmitting standby only under certain conditions.

In a generally known manner this takes place thereby that the microphone user manually actuates a transmission button.

From GB 20 03 002 A is known a device which automatically closes a transmission switch in the event the microphone input level suddenly increases.

In De-OS 34 01 883, lastly, the proposal is made to switch a microphone by means of an approximation sensor - which detects the approximation of the head of the operator to the microphone for the purpose of speaking - over to transmission standby.

In all of these devices only one (speech) microphone is used.

From US 33 83 466 further a process for speech recognition is known in which, in addition to measuring sensors for the lip movements of an operator and the air flow between their lips, a first microphone is disposed on the throat and a second in the nose of the operator. Through the two complicated measuring sensors and the microphone in the nose this process becomes unsuitable for broad use at the work place or in motor vehicles.

The invention has the task of improving the process according to the preamble of patent claim 1 such that an interpretation of pure background noises as the beginning of a speech command can be excluded with certainty and of specifying a device for carrying out the process according to the invention.

This task is solved according to the invention with the characterizing characteristics of the process claim 1 or of the device according to claim 2.

The dependent claims with their characterizing characteristics disclose advantageous developments of the device according to the invention.

Since body sound generated during speaking can be picked up with extremely short delay at the head or neck, especially at the throat of the operator, a signal generated through a body sound microphone is extremely well suited to detect the beginning of a speech command. The speech microphone proper, which is also impressed with background noises, can be switched on electrically for speech signal transmission through the body sound signal precisely at the time of the speech command beginning without error possibility. For this purpose the operator does not need to carry out any intentional hand or head movements since, according to one embodiment of the device, both microphones can be worn on suitable harnesses. The operator is also kept from any movement sequence, especially if further also a portable transmitter is provided, which transmits the speech commands wirelessly to

a corresponding receiver.

While the electric signals of the body sound microphone alone are not sufficient for the speech recognition, since they, for example, cannot reproduce any formants and nasal sounds, yet they further improve the transmitted speech pattern of the speech microphone if they are linked with their electric signal in suitable manner, for example through in-phase addition.

It is further advantageous if the speech microphone is always switched off automatically if pauses occur in the speech. The switch-on duration can also be limited automatically to the permissible word receiving duration of the speech recognition. In the latter case, signaling to the operator takes place.

An embodiment example of a device according to the invention is depicted in the drawing and will be described in further detail in the following. Therein show:

Fig. 1 a schematic representation of the device, and

Fig. 2 the connections of the microphones and the trigger circuit in a block circuit diagram.

On a neck harness 1 is fastened a first microphone 2 - implemented as a double throat microphone - to be put on the neck of a (not shown) operator. On a head harness 3, which is part of a head set 4, a second microphone 5 is fastened to be directed to the mouth of the operator. From the first microphone 2 a signal line 6, into which is looped an interrupter switch 6.1 to be manually actuated, leads to the head harness 3 and from there, together with a signal line of the second microphone 5, is introduced in a flexible cable 7 via a multipole plug connection 8 into a first casing part 9.1 of a casing 9.

In the first casing part 9.1 is disposed a trigger circuit 10 - here only represented schematically with a transistor symbol - to which are supplied the electric signals of the two microphones 2 and 5. Lastly, a signal transmitter 10.3 is indicated, which can be activated by a time element provided in the trigger circuit 10 and transmits an optic or acoustic signal when the maximum word receiving duration of a speech recognition circuit 14 is being exceeded.

In a second casing part 9.2 of casing 9 are disposed a transmitter 11 and an

electric energy store 12. The transmitter 11 corresponds with a receiver 13 of the speech recognition circuit 14. On the second casing part 9.2 advantageously a carrying handle or belt 15 can be attached.

In the strongly simplified block circuit diagram of Figure 2, the switching symbols corresponding to the already described switching elements of the device are provided with identical reference numbers.

The trigger circuit 10 comprises essentially a threshold value switch 10.1 with a reference value, settable for example on a potentiometer and a normally open switch 10.2 controllable by the threshold value switch 10.1, which is here looped into the signal path of the second microphone 5. The normally open switch 10.2 comprises advantageously a time element T which, after passage of the maximum word receiving duration of the speech recognition circuit 14, opens the switch 10.2 and activates the signal transmitter 10.3 for said purpose.

The transmitter 11 can operate according to any desired principle of wireless signal transmission. As an example, an infrared diode is shown in the Figure.

Further are disposed in the first casing part 9.1 additionally an amplifier 16 for the signals of the first microphone 2 and an amplifier 17 for the signals of the second microphone 5.

Upon impression of the first microphone 2 with body sound, after the response of the threshold value switch 10.1, the switch 10.2 is closed or becomes transmissable for the amplified and filtered signals of the second microphone 5.

Should the operator need to cough or clear his throat, he can prevent an undesirable signal transmission with the interrupter switch ("cough key") 6.1.

Lastly, an acoustic signal which marks the point at which the maximum word receiving duration is exceeded, can also be supplied to the operator advantageously via the head set 4 instead of via directly radiating signal transmitter 10.3.

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2 sheets of drawings enclosed

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Fig. 2

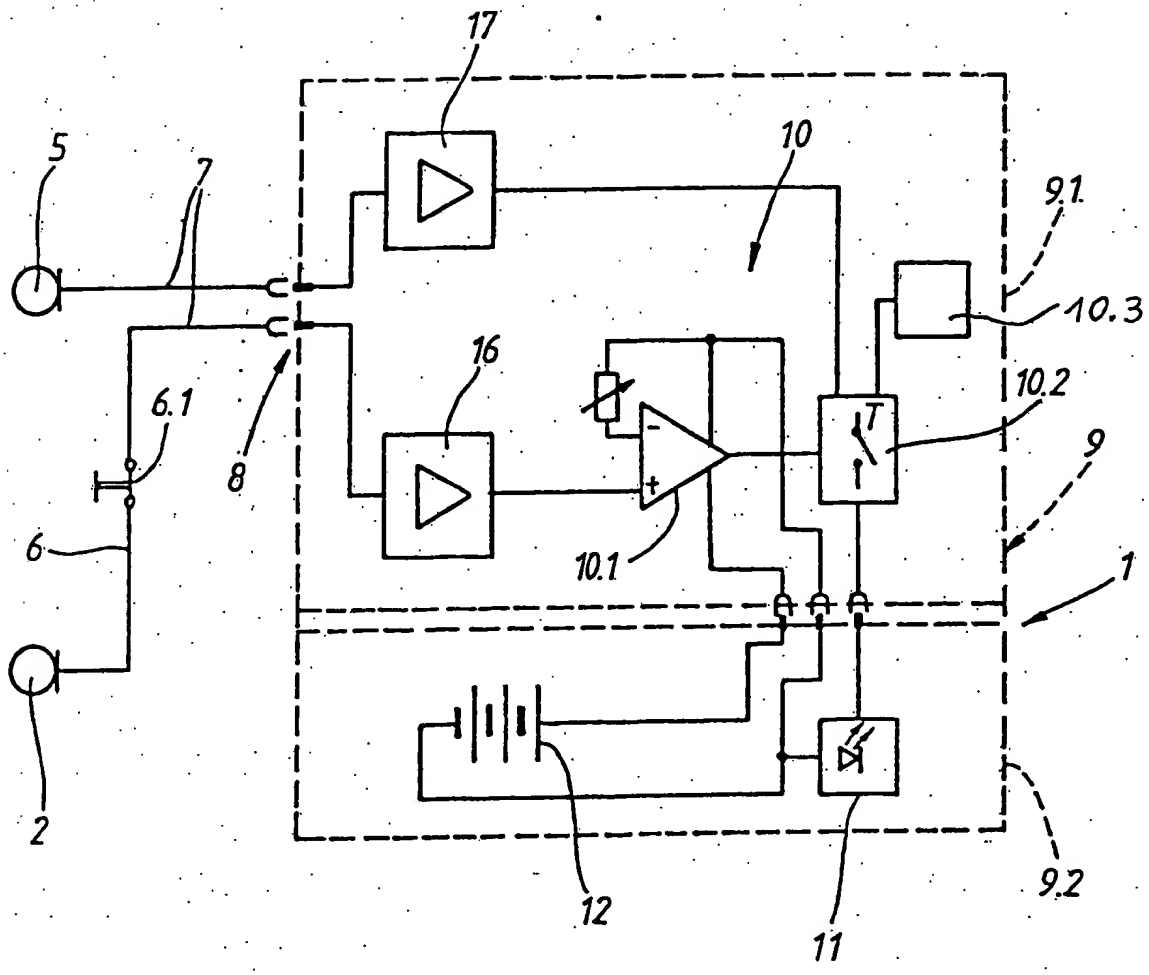

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Fig. 1